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Amendments to the Specification

Please replace the Title with the following amended Title:

~~METHOD AND SYSTEM OF COMPENSATING FOR DATA STORAGE~~ DISC ~~STACK~~ IMBALANCE COMPENSATION DURING DISC DRIVE ASSEMBLY

Replace paragraph [0002] with the following:

The static imbalance of data storage disc stack assemblies, usually expressed in milligram-centimetres ("mg-cm"), has recently become a critical performance parameter in disc drive design. This is primarily due to the increasing demand for precision performance in the consumer data storage product market. High imbalance of the disc stack may lead to structural vibration and undesirable noise, both of which are unacceptable in consumer products such as games-boxes and audio-video products. Furthermore, the industry standard specification for drive level imbalance has been reduced from an industry standard, 70 mg-cm to the current state of the ~~aft~~ art, 50 mg-cm.

Replace paragraphs [0005-0007] with the following:

Research has shown that the disc clamp offset and the clamp offset angle are two of the most important factors contributing to static imbalance. However, corrective actions typically involve major design changes and added cost such as ~~Active Balancing~~ active balancing which requires a design change and the addition of counter-balance weights. These solutions also require extra manufacturing floor space and labor to perform the corrective balancing.

Accordingly there is a need to develop a way of compensating for the disc clamp offset without a major design change or extensive costs. The embodiments of the present invention ~~provides~~ provide a solution to this and other problems, and offers other advantages over the prior art.

SUMMARY OF THE INVENTION

Against this backdrop embodiments of the present invention have been developed. ~~One embodiment is~~ In some embodiments a method is provided of compensating for imbalance in data storage disc stack processing during assembly of the data storage device. The method incorporates an optical measurement system downstream of the disc clamp installation operation. The introduction of a real-time optical measurement system into the assembly line has numerous strategic advantages. The system measures multiple parameters of a most recent set N of incoming disc-stacks produced on the assembly line, where N is a suitable sample size, such as 30 disc stacks. The measured parameters include disc clamp ~~Offset~~ offset, clamp offset angle, ring outer diameter, ring offset, and ring offset angle, where the disc clamp may be installed with a spring expansion ring designed to center the clamp with respect to the axial centerline of the drive motor. The optical capabilities of the system provide quantitative measurement of the install conditions for the clamp and other components, which permits optimization of the components and machine settings. For instance, the optical system may inspect the ring closure condition to avoid reliability issues due to slippage of the disc media.

Replace paragraphs [0010-0017] with the following:

The above techniques of using optical measurement feedback to selectively install

predetermined clamp configuration types to counter balance the disc stack imbalance during disc drive assembly has proven to be effective and feasible. The concept could be extended to the measurement of media and non-symmetrical component offsets with respect to the motor's center axis for achieving further drive balance improvement. These and various other features as well as advantages which characterize embodiments of the present invention will be apparent from a reading of the following detailed description and a review of the associated drawings.

FIG. 1 is a plan view of a disc drive assembled in accordance with ~~a preferred embodiment~~ embodiments of the present invention showing the primary internal components.

FIG. 2 is a cross sectional view through the disc drive in FIG. 1 taken along line 2-2.

FIG. 3 is an operational flow diagram of an assembly process in accordance with a ~~preferred embodiment~~ embodiments of the present invention.

FIG. 4 is a model schematic of an optical measurement system for determining and feeding back clamp configurations that compensate for disc stack imbalance in accordance with ~~a preferred embodiment~~ embodiments of the present invention.

FIG. 5 is a plan view of a disc clamp and a spring expansion ring configuration, illustrating measurements utilized in an absolute calibration of an optical measurement system in accordance with ~~a preferred embodiment~~ embodiments of the present invention.

FIG. 6 is an operational flow diagram illustrating an optical measurement logic flow of an optical measurement system in accordance with ~~a preferred embodiment~~ embodiments of the present invention.

FIG. 7 is an operational flow diagram illustrating a clamp configuration type

selection logic flow of an optical measurement system in accordance with a ~~preferred embodiment~~ embodiments of the present invention.

Replace paragraph [0018] with the following:

A disc drive 100 constructed in accordance with ~~a preferred embodiment~~ embodiments of the present invention is shown in FIG. 1. The disc drive 100 includes a base 102 to which various components of the disc drive 100 are mounted. A top cover 104, shown partially cut away, cooperates with the base 102 to form an internal, sealed environment for the disc drive in a conventional manner. The components include a spindle motor 106 which rotates one or more discs 108 at a constant high speed. Information is written to and read from tracks on the discs 108 through the use of an actuator assembly 110, which rotates during a seek operation about a bearing shaft assembly 112 positioned adjacent the discs 108. The actuator assembly 110 includes a plurality of actuator arms 114 which extend towards the discs 108, with one or more flexures 116 extending from each of the actuator arms 114. Mounted at the distal end of each of the flexures 116 is a head 118 which includes a fluid bearing slider enabling the head 118 to fly in close proximity adjacent the corresponding surface of the associated disc 108.

Replace paragraph [0022] with the following:

FIG. 2 shows a cross sectional view of a disc stack assembly 200 within the disc drive 100 ~~incorporating a preferred embodiment~~ in accordance with embodiments of the present invention. The disc stack assembly includes the spindle motor 106, the discs 108, a disc clamp 210 that secures the discs 108 to the spindle motor 106, and a spring expansion

ring 208 designed to self-center the disc clamp 210 with respect to the axial centerline of the spindle motor 106. The components of the spindle motor 106 include a disc support flange 214 that is ~~pressed~~ press fit onto a rotating hub 206 and supports the discs 108. The rotating hub 206 is mounted via a bearing 204 to a stationery spindle 202, which is press fit into the base plate 102 of the drive 100. Stator coils 218 are spaced laterally from the bottom of the rotating hub 206 and permanent magnets 216 are attached and extended from the bottom of the disc support flange 214 just outboard the stator coils 218. The application of current to the stator coils 218 causes magnetic interaction between the permanent magnets 216 and the stator coils 218 such that the hub 206 rotates about the stationary spindle 202 carrying the discs 108 via the flange 214.

Replace paragraph [0024] with the following:

FIG. 3 shows an operational flow diagram of a disc drive assembly process 300 that compensates for disc stack imbalance in accordance with ~~a preferred embodiment~~ embodiments of the present invention. Process 300 starts with "BEGIN operation 301. Control is then passed to operation 302.

Replace paragraph [0026] with the following:

Operation 306 selects the clamp configuration type 210 to be installed on the disc stack 200. The operation 306 may receive a predetermined or selected clamp configuration type ~~210~~ to be installed from operation 328 once N samples have been measured and averaged in operations 310 and 322 respectively. Next, control passes from operation 306 to operation 308 where the selected clamp configuration type ~~210~~ is installed onto the disc

stack 200. The clamp 210 is secured with the spring expansion ring 208 during operation 308. The base plate 102 with the disc stack 200 installed then enters the optical measurement system and control passes to operation 310.

Replace paragraph [0034] with the following:

FIG. 4 shows a model schematic of an optical measurement system for determining and feeding back clamp configuration types that compensate for disc stack imbalance in accordance with ~~a preferred embodiment~~ embodiments of the present invention. Components of the optical measurement system 400 include a code reader 402 for detecting when a disc stack 200 arrives at the optical measurement work zone and for reading the barcode tags attached to the base of the drive motor 106 for each disc stack 200. The bar codes identify the serial number and the machine or assembly line install number for each disc stack 200. Based on the serial number, and through a network database, a computer 404 of the optical measurement system 400 is notified as to whether the disc stack 200 has had a failure at any of the work zones upstream on the assembly line before arriving at measurement system 400. The[[,]] bar code will also reference process information through the network database such as information regarding what supplier provided the clamp 210, drive base 203 or motor 106. If the disc stack has experienced a failure at a prior work zone or if any of the required process information is not valid or in place, the disc stack will be bypassed through the optical measurement system 400 and no further processing will occur. The code reader 402 is interconnected with the computer 404 through a standard interface 403.

Replace paragraph [0036] with the following:

FIG. 5 shows a plan view of a disc clamp 210 and a spring expansion ring 208 configuration via an image capture 500, illustrating measurements utilized in an absolute calibration of the optical measurement system 400 in accordance with ~~a preferred embodiment~~ embodiments of the present invention. Image capture 500, captured by the digital camera 406, is utilized to calibrate the optical measurement system 400. Absolute calibration of the system 400 is conducted to ensure precise measurements during the measurement operation. A special marking on the clamp 210 defines the zero reference angular orientation 503. Subsequent angle measurements will be clock-wise from this zero reference marking 503. Compensating notch 505, located at the zero angle reference, is referred to as the center notch 505. The center notch 505 is usually located at the zero reference angle.

Replace paragraph [0038] with the following:

FIG. 6 is an operational flow diagram illustrating an optical measurement logic flow of an optical measurement system in accordance with ~~a preferred embodiment~~ embodiments of the present invention. The optical measurement operation 600 measures and computes disc stack parameters that are fed back to the clamp installation operation to identify a clamp configuration type that will compensate for the calculated parameters according to offset trends. The optical measurement and calculation operation, according to ~~a preferred embodiment~~ embodiments of the present invention, starts with operation 602.

Replace paragraph [0051] with the following:

~~and wor(t~~ (a_i-A_t) ranges from +/-(0 to 180), if>180 use (360- ~~(as i~~ (a_i-A_t)) and where D_{ki} represents a two dimensional matrix where "k" is the machine code and "i" is the clamp supplier code. Operational control then passes to operation 619.

Replace paragraphs [0063-0064] with the following:

In summary, the present ~~invention~~ embodiments can be viewed as a method (such as shown in operational flow 300) of compensating for imbalance in a data storage disc stack (such as 200) within a data storage device (such as 100) during assembly of the data storage device (such as 100), the disc stack (such as 200) having components including a drive motor (such as 106) having a stationary stator (such as 218) and a hub (such as 206) that rotates about a stationary spindle (such as 202), the hub (such as 206) having a disc support flange (such as 214) supporting one or more data storage discs (such as 108) secured to the flange by a disc clamp (such as 210).

The method (such as shown in operational flow 300) of the present ~~invention~~ embodiments can be viewed as comprising the acts of: optically measuring one or more disc stack parameters, including disc stack component offsets and disc stack component offset angles for a most recent N disc stacks (such as 200) produced on an assembly line; calculating a moving average of the most recent N disc stack component offsets and the most recent N offset angles; utilizing the calculated averages to determine a desired component configuration type; and feeding back the desired component configuration type to a component installation station to select the desired component configuration type for installation in a next disc stack (such as 200).

Replace paragraph [0072] with the following:

It will be clear that the present ~~invention is~~ embodiments are well adapted to attain the ends and advantages mentioned as well as those inherent therein. While ~~a presently preferred embodiment has~~ embodiments have been described for purposes of this disclosure, various changes and modifications may be made which are well within the scope of the embodiments of the present invention. For example, the concept could be extended to the measurement of media and non-symmetrical component offsets with respect to the motor's axis for further drive balance improvement. Numerous other changes may be made which will readily suggest themselves to those skilled in the art and which are encompassed in the spirit of the ~~invention~~ embodiments disclosed and as defined in the appended claims.